

NUTRITIONAL KNOWLEDGE AND ATTITUDES OF STUDENTS
AT THE UMKC SCHOOL OF DENTISTRY

by

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B.S., Colorado State University, 1975

A MASTER'S THESIS

submitted in partial fulfillment of the
requirements for the degree

MASTER OF SCIENCE

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Department of Foods and Nutrition

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1979

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INTRODUCTION

Nutrition is currently a topic of great importance among health professionals and the lay public alike. Because of this awakening of interest, a large volume of information and misinformation concerning the relationship of nutrition to health has proliferated. Separating fact from fallacy is not an easy task, and health professionals are often consulted by their patients for answers to nutrition-related questions. Knowledge of nutrition, however, is often inadequate among some groups in the health field.

A nutrition knowledge survey of Nebraska physicians yielded an average of 65% correct responses.¹ Students in four Eastern medical schools scored 46%, 35%, 37%, and 39%, respectively, on a test of their knowledge of normal and therapeutic nutrition.² When tested for knowledge of nutrition, a group of 867 registered nurses in Nebraska gave approximately 50% correct responses.³ Canadian health nurses made mean scores of 74.9% on nutrition knowledge and 65.1% on personal nutrition practices.⁴ Harrison and co-workers⁵ found wide variation in nutrition knowledge among a group of American public health nurses; their overall mean score, however, was 62%. Dental students at the University of Kentucky⁶ scored 58.7% on a nutritional knowledge test.

Among the health professions, an increasing awareness of nutrition has not escaped the field of dentistry. The relationship of nutrition to oral health and disease is well-documented.⁷⁻¹⁷ Moreover, nutritional counselling is becoming an integral part of modern preventive dental practice.^{13,18-20}

In addition to the application of nutritional counselling to treatment of dental caries and periodontal disease, there is a growing realization

of the important role dentists can play in screening for and detection of nutritional problems which affect the general state of health of the entire body.²¹ Scrimshaw and Ascoli²² stated: "The dentist is in a favorable position to observe . . . nearly all the areas in which signs suggestive of nutritional deficiency are commonly encountered. The dentist should become familiar with the clinical signs . . . and should look for them routinely in his patients."

In contrast to other health professionals whose practices involve mainly ill persons, the emphasis placed on regular dental checkups puts the dentist in a unique position. Periodically, he has the opportunity to clinically observe apparently "healthy" people so that when problems are noted, he may refer patients to other health professionals. This situation also gives the dentist an excellent opportunity to disseminate reliable nutrition information to his patients.

If the dentist is to function effectively in this complex role of monitor of nutritional health, resource person, and educator, it is imperative that he be knowledgeable about normal and therapeutic nutrition, and about the variety of food fads and fallacies that abound today. This demands the ability to read critically and evaluate the scientific and popular literature. A number of articles concerning nutrition have appeared in the recent literature which may confuse or mislead the poorly informed professional.²³⁻³⁶ In addition, programs involving patient nutritional assessment and aimed specifically at dentists have emerged in recent years.²⁸⁻³⁰ The ideas promoted by such programs have come under fire by experts in the fields of medicine, nutrition, and dentistry.³⁷⁻⁴⁰ A clear understanding of the principles of nutrition and biochemistry is

necessary if the dentist is to be able to critically evaluate programs of this nature.

The dental student of today is the dentist of tomorrow. The knowledge gained and the attitudes formed by the student with regard to nutrition will be carried with him into private practice, and will ultimately influence the care delivered to his patients. The dental student's nutritional knowledge and attitudes are shaped, in part, by the degree of emphasis given the subject in the dental school curriculum, current research findings, and the fascination with nutrition which exists in contemporary society.

The purpose of this study was to assess the nutritional knowledge and attitudes of the first and fourth-year students in the School of Dentistry at the University of Missouri at Kansas City.

REVIEW OF LITERATURE

It is widely accepted that nutrition is important to health--both general body health and that of the oral cavity. In 1965, a conference was held to define what the content of nutrition courses taught in dental schools should be and how the information might best be conveyed.⁴¹ The conclusions drawn from the conference were two-fold:⁴² a) Dentists need skills in clinical nutrition. b) Dental schools have a responsibility to provide students with the opportunity to learn and apply accepted principles of nutrition. Similar recommendations came from the 1969 White House Conference on Food, Nutrition, and Health:⁴³ a) A separate nutrition course should be offered by all schools of dentistry and dental hygiene, in order to make available additional avenues of preventive dental care.

b) Individualized diet counselling for control of dental caries should be an essential part of total dental health care.

Despite its importance to general and oral health, nutrition is not a priority for many dentists. Lack of exposure to nutritional principles may be one reason for this. In 1969, while 61% of U.S. dental schools required a course in nutrition for all students, only about 25% provided demonstrations on patient nutritional counselling, and only 11% provided the opportunity for students to counsel actual patients themselves.⁴⁴ When New York dentists were surveyed in 1973 in order to assess their degree of interest in a variety of proposed topics for continuing education programs, nutrition was not included for consideration among the 21 proposed topics.⁴⁵

Lack of understanding of nutrition also may contribute to its low priority among some dentists. Bozdech et al.⁶ examined knowledge of nutrition among 178 dental students at the University of Kentucky, a school noted for excellence of its dental program. The students made a mean score of 58.7% on a knowledge test, which was below the mean score of undergraduate students who had earned only a grade of "C" in a basic nutrition course at that university. The lowest mean scores made by dental students were made on the categories of diets (41.7%) and nutrition, biochemistry, and physiology (normal nutrition) (55.9%). Inadequate knowledge of diets, foods and food groups was observed among dental students as evaluated by dietetic interns.⁴⁶

Garverick et al.⁴⁷ surveyed New York dental students before and after their required nutrition course, in order to determine their level of interest in 10 nutrition-related dental topics. Interest was lowest for certain topics related to normal nutrition (endocrine glands and nutrition,

nutrition for the aged patient) and highest for some topics more intimately related to dental practice (diet and rampant caries, oral manifestations of nutritional disturbances). Interest in some topics related to diets ranged between the two extremes (dietary advice for children and pregnant patients). Akst et al.⁴⁸ surveyed 347 dentists in 47 states and Canada and found that while 98.3% of them stated that they practiced preventive dentistry, only 18.5% performed any type of nutritional analysis or dietary evaluation on their patients.

Three factors--lack of exposure, lack of knowledge, and lack of interest in nutrition--may interfere with dentists' abilities to interpret critically the abundance of nutrition-related information appearing in the current popular and scientific literature. In many instances, controversial data exist, and professionals and laymen with weak nutrition backgrounds may be susceptible to misinformation, faddism, and quackery. It has been reported that nutrition education is one of the most effective means of combatting these pitfalls.^{49,50} Some topics of particular importance to the dentist are nutritional needs of various groups within the population, nutrition in relation to disease, nutrition and oral health, diets, specific nutrients, nutritional properties of foods and food products, and assessment of nutritional status.

Nutritional Needs

The dentist in general practice cares for patients of all ages. If optimum care is to be provided, an awareness of changing nutritional needs over the life span is necessary. Any dietary modifications recommended by the dentist must be compatible with the needs of the individual patient. Some key nutritional issues at various stages of the life cycle will be discussed.

In Pregnancy And Lactation. It is well-known that nutritional requirements increase during pregnancy.⁵¹ Sodium is one nutrient which is needed in larger amounts during gestation, perhaps up to 2000-3000 mg more per day than in the non-pregnant state.^{52,53} The common practice of sodium restriction during pregnancy places undue strain on the body's mechanism for conserving this electrolyte. Although outdated and potentially harmful, the belief that sodium should be routinely limited during normal pregnancy still persists.^{52,53}

Iron requirements also are elevated in the pregnant female.⁵⁴ Because dietary iron cannot normally meet the extra demands imposed by pregnancy, iron supplements usually are prescribed, particularly during the last two trimesters.⁵²

Weight gain during pregnancy has long been a controversial subject. It is now accepted that maternal weight gain should not be rigidly restricted. Neither should weight loss be attempted during gestation, since both of these practices are related to lower birth weight and increased infant mortality rate.^{52,53}

Lactation imposes still further demands on the body for calories, protein, water, calcium and other minerals, and vitamins.⁵⁴ Volume of milk production is dependent in part on adequate intake of energy and fluids.

In Infancy. The rate of growth for an infant during the first year of life is more rapid than at any other stage of the life cycle. Because of this, nutrient requirements per pound of body weight are far greater for infants than for adults.⁵⁵

In recent years, breastfeeding has enjoyed a resurgence of popularity as the preferred means of nourishing newborns. Breast milk provides many

essential nutrients in the proper proportions to meet the needs of human infants. Some vitamins and minerals, however, are present in low levels in human milk. It is recommended that the exclusively breastfed infant be given supplemental vitamin D, ascorbic acid, iron, and fluoride, since breast milk alone tends to be too low in these nutrients to meet the needs of a child after the first few months of life.^{56,57}

In Adolescence. Because of the rapid growth rate, physical maturation, and the high activity levels of many adolescents, the total nutrient requirements of this age group are higher than for fully mature adults. In particular, calories and certain B-vitamins that serve as cofactors in energy metabolism are needed by adolescents in amounts greater than at any other time of life.⁵⁴

In The Later Years. Two minerals, calcium and iron, are of concern in the diets of the elderly. These two nutrients have been reported by some workers to be present in inadequate amounts in the diets of older Americans.⁵⁸⁻⁶¹ Low dietary iron intake correlates with poor hematologic iron status in persons aged 60 and over.⁶¹

A suboptimal intake of calcium over the lifespan has been related to an increased incidence of osteoporosis (bone loss) in old age.^{62,63} Some workers believe that osteoporotic changes in the jaw bone lead to periodontal disease and tooth loss.^{64,65} Most researchers believe that while nutritional deficiencies such as calcium probably are not the cause of periodontal disease, they do influence its severity.⁶⁶ Jowsey⁶³ suggested that the ratio of phosphorus to calcium in the diet may be more important in the development of osteoporosis than the absolute amount of calcium ingested.

Nutrition In Oral Health And Disease

Nutrition is of interest to the dentist because of the dual role it plays in oral health. On one hand, nutritional factors are fundamental in the development of normal oral tissues and organs and in the maintenance of optimum conditions of health in the mouth. On the other hand, nutritional factors also are involved in the pathogenesis of oral diseases.

Developmental Influences Of Nutrition. Normal development of the teeth and soft oral tissues is intimately related to the nutrients available during the formative period. The importance of adequate protein-calorie nutrition during pregnancy and lactation to development of normal teeth has been demonstrated in rat studies.⁶⁷⁻⁶⁹ When a low protein diet was fed to pregnant and lactating rats, the offspring exhibited growth retardation, smaller teeth, delayed eruption of teeth, and increased susceptibility to caries (dental decay) later in life. In a related experiment, the pups of mothers fed the deficient diet during pregnancy and lactation were fed protein-supplemented, cariogenic diets after weaning. When compared to weanling rats fed a protein-deficient diet, the supplemented rat pups gained more weight and had a lower incidence of caries. Protein restriction during tooth formation in rats also produced impaired function of the submandibular salivary glands and a reduction in salivary flow.^{67,69} Reduced flow of saliva encourages progression of dental caries.

Other nutrients, such as calcium, phosphorus, fluoride, and vitamin D also are critical in the formation of healthy, caries-resistant tooth enamel.^{11,13} Tooth formation begins with the synthesis of a protein matrix. The matrix is calcified to form the hard, inert enamel surface of

the tooth. The calcification process begins before birth and continues until the age of 15-18 years in humans. Normal mineralization of the enamel requires adequate supplies of calcium, phosphorus, vitamin D, and fluoride.

The action of fluoride in caries-resistant enamel formation is not entirely understood. It is thought that the fluoride ion may substitute for a hydroxyl group on the hydroxyapatite crystal that composes tooth enamel, producing a larger, more dense crystalline structure, known as fluoroapatite.¹¹ This compound is less soluble in acids which are produced by microorganisms in the mouth. Other ways in which fluoride increases caries resistance are by accumulation on the tooth surface as calcium fluoride, and possibly remineralizing some early carious lesions.¹¹ Because the mineralization of enamel continues through the first 1 1/2 to 2 decades of life, addition of fluoride to drinking water, or topical application of fluoride to the tooth surface is of benefit during this entire period. However, the greatest protective effect is obtained from fluoride ingestion during tooth formation.⁷⁰

Nutritional factors affect the development and maintenance of healthy periodontal tissues (the gingiva, periodontal ligament, the alveolar bone). These tissues contain a large percentage of collagen. Ascorbic acid is known to play a focal role in collagen synthesis.⁷¹ Thus adequate amounts of vitamin C are necessary for the formation of normal periodontal connective tissues. Calcium and phosphorus are needed for optimum mineralization of the alveolar bone in which the teeth are embedded.¹³ A diet consisting of firm, chewy foods stimulates the gingiva and may increase circulation to the tissues. In addition, the stress on the alveolar bone that results from chewing firm foods favors bone

mineralization and reduces bone resorption.^{13,20} Conversely, a diet consisting mainly of soft foods may have the opposite effect.

Many other nutrients exert an influence on the development of normal periodontal tissues, tooth formation, and resistance to infection. The mechanisms for their effects are not fully understood at present, and study is continuing.

Nutritional Factors In Oral Diseases. Nutrition influences the occurrence and severity of the two most common oral diseases, dental caries and periodontal disease.^{11,70} Dental caries is a localized, progressive demineralization of the tooth enamel and dentin by organic acids produced when carbohydrates are fermented by the oral microflora.¹¹ It affects over 90% of the world's population.⁷⁰ Periodontal disease is a chronic, progressive disease of the structures which support the teeth, namely, the gingiva, alveolar bone, and periodontal ligament.¹¹ The disease is characterized by inflammation of the gingiva which progresses to destruction of the gingival tissue and demineralization of the underlying bone. Ultimately the teeth loosen and fall out. Eighty to 90% of American adults are affected to some extent by periodontal disease.⁷²

These two pathological conditions are responsible for most of the tooth loss experienced by Americans. Prior to age 35, dental caries is the major culprit, while periodontal disease is the primary reason for tooth loss after age 35.¹¹

Dental caries. Nutritional factors influence the development of dental caries in several ways. Three "ingredients" are required for the development of carious lesions.^{11,70}

First, a tooth must be susceptible to erosion by acids. Susceptibility may be a result of incomplete calcification of the enamel during tooth formation, or other factors related or unrelated to nutrition.^{64,67-70} Ingestion of fluoride during tooth mineralization yields a more dense, less soluble surface, thereby reducing susceptibility to erosion.^{11,70} In the classical fluoridation studies conducted in the 1940's and 1950's,¹⁷ a 58% lower DMF (decayed, missing or filled) rate was reported among teeth of children who had consumed 1 ppm of NaF in the drinking water during the first ten years of life, when compared to teeth of children consuming unfluoridated water. Schlesinger⁷³ has reviewed numerous other studies confirming these findings.

The second factor necessary for caries to occur is the presence of bacterial plaque on the teeth.⁷⁰ Dental plaque is a sticky, colorless substance composed of a protein-polysaccharide matrix in which oral bacteria (notably Streptococcus mutans) form colonies. This substance adheres to the teeth and accumulates in the gingival crevices.^{11,70} Toothbrushing alone does not remove plaque from the interdental spaces or the gingival crevices; this must be accomplished by daily flossing in addition to brushing.

The third factor involved in dental caries is a source of dietary carbohydrate.^{11,70} Plaque formation usually is initiated by the ingestion of sucrose. Once plaque forms, nearly any carbohydrate can be fermented by S. mutans to form acids which, in turn, dissolve the enamel. Although sucrose is frequently implicated in caries, it is not the only culprit. Rampant caries have been reported in children allowed to breastfeed at will after their teeth have erupted.^{7,74} The high lactose content of human milk is an excellent substrate for bacterial fermentation.

Other factors than the type of carbohydrate consumed affect plaque formation and acid production.^{11,13,20,70} The form of the carbohydrate is of importance. Liquid carbohydrate sources, such as milk, fruit juices, and carbonated beverages containing sugar are more rapidly cleared from the mouth than are sticky forms of carbohydrate. Chewy candies, dried fruits, baked goods, and starchy vegetables tend to cling to the teeth and become lodged between them. Because such retentive carbohydrates are in contact longer with the bacteria in plaque, there is more opportunity for fermentation to acids. Retentive carbohydrates are generally believed to be more cariogenic than more rapidly cleared forms.^{11,13,20,70}

Frequency of ingestion of fermentable carbohydrates is probably more critical than the total amount consumed.^{11,70,75} If plaque is present, each time carbohydrate is consumed, acids will be produced. The oral pH may drop as much as 3 pH units when sucrose is ingested, reaching the lowest level from 2-30 minutes after ingestion. The pH then rises slowly, and may not reach the pre-ingestion level for 1/2-2 hours. Demineralization of enamel will occur at a pH of about 5.0 or lower. Repeated renewal of carbohydrate at intervals throughout the day may maintain a low oral pH for long periods of time, keeping the caries process active.⁷⁵

All three factors--susceptible tooth, bacterial plaque accumulation, and fermentable carbohydrate--must be present for caries to occur. Any intervention which eliminates one of these factors will inhibit the caries process. Nutritional factors play a role in the modification of at least two of these three factors.

Periodontal disease. Periodontal disease is related to nutrition in several ways. Nutritional factors may be involved in the etiology, course, therapy, and outcome of the disease process. Some workers believe

that periodontal disease is initiated by chronic calcium deficiency, which leads to bone loss as age advances. Because demineralization of the alveolar bone is one characteristic of periodontal pathology, an attempt has been made to establish bone loss due to calcium deficiency as a causative agent. Krook et al.⁷⁶ treated periodontal patients with calcium supplements and observed clinical improvement in bleeding, tooth mobility, and bone resorption.

Deficiencies of protein, vitamins A, B-complex, C and D, and phosphate, copper, and magnesium have been proposed as conditions which weaken the body's resistance to periodontal disease.^{13,14,20} It has been suggested that diminished resistance allows the disease to become established and progress more rapidly than when the diet is adequate in nutrients.

Most workers in the field of oral pathology believe that periodontal disease is not a result of nutritional deficiencies or imbalances, but is initiated by dental plaque accumulation.^{11,66,70} The metabolites produced by the plaque bacteria produce a localized inflammatory response in the gingival tissues. Without therapy, progressive damage to the periodontal tissues and alveolar bone ensues, with resultant tooth loss.⁷⁰

While nutrition may not be the cause of periodontal disease, nutritional factors do have some influence on the type and amount of plaque formed, as was discussed previously.^{11,70} Thus, indirectly, there is a relationship between nutrition and the initiation of periodontal disease.

The role of nutrition in the treatment of periodontal pathology is being debated at the present time. Nizel^{13,20} stated that inclusion of firm, chewy foods in the diets of periodontal patients may be of value in stimulating calcium deposition in the alveolar bone. Other workers³¹⁻³⁵ have reported therapeutic benefits from megadoses of vitamins, minerals

and other nutritional supplements. Some of these findings have been questioned by other researchers in oral medicine.^{38,39} Before any definite statements can be made about the value of megadoses of nutrients in periodontal therapy, more work needs to be done.

Nutritional Assessment And Counselling In Preventive Dental Practice

In recent years, there has emerged a growing interest among dental health professionals in the role nutritional assessment and dietary counselling can assume in a modern preventive dental practice.^{13,18-20,22,29,43,48} If a dentist is to make effective use of nutritional findings and opportunities for counselling, he or she needs to have a sound knowledge of the appropriate techniques for nutritional assessment of the dental patient, tools and resources available, and methods of counselling.

Nutritional Assessment. Assessment of the nutritional status of the dental patient can provide meaningful information to the dentist. Potential problems may be anticipated and existing problems treated or referred to other professionals.²¹ In order for nutritional assessment to be of value, appropriate methods for gathering data must be used and the data must be evaluated according to established and reliable standards. Components of the nutritional assessment which are of importance to the dentist include medical and drug history, anthropometric measurements (height, weight, weight history), clinical oral findings such as symptoms suggestive of vitamin and mineral deficiencies, dietary intake information such as a diet history, 24-hour recall, food record or food frequency list, and in some cases, biochemical measurements such as bloods values (hemoglobin, hematocrit, lymphocyte count, etc.) and serum nutrient concentrations.

Cottone and Kafrawy²¹ reported that 43% of dental patients were taking at least one medication on a regular basis. Commonly used medications included analgesics, antihypertensives, psychotherapeutic agents, hormones, antibiotics, antihistamines, cardiac agents, hypoglycemic agents, anticoagulants, oral contraceptives, antiasthmatics, anticonvulsants, vitamins, antacids, anorexic agents, and cold remedies. Many of these medications influence or are influenced by nutrients in the diet, and many of these drugs alter digestion, absorption, metabolism, or excretion of nutrients.

Medical history. A medical history is an important part of nutritional assessment. In one study,²¹ 38% of dental patients had multiple significant medical problems which were revealed in their medical histories. Allergy, cardiovascular disease, and endocrine disorders including diabetes mellitus were noted in 19%, 15%, and 6.5% of the subjects, respectively. These conditions frequently are related in some way to nutrition.

Blood analysis. Assessment of nutritional status with regard to some blood and serum parameters may give important insight into potential complications of operative dental procedures. Hemoglobin, hematocrit, serum albumin, and serum total protein are easily obtained measurements and are useful indicators of iron and protein status.⁷⁷ Some other nutrients, such as calcium, are not easily assessed by means of a blood sample because the body's homeostatic mechanisms maintain stable levels of these nutrients in the blood, even in the presence of dietary deficiencies. The dentist should be aware of this fact. A knowledge of normal ranges for blood and serum parameters is vital if this type of biochemical data

is to be used effectively. There are many good resources which provide this information.^{78,79}

Hair analysis. Analysis of hair for mineral status is currently being used by some dentists.^{29,32} However, Deeming and Weber,⁸⁰ and Klevay^{81,82} have obtained poor correlations between hair values and dietary intake or serum levels for most minerals. In addition, the range of hair mineral concentrations varies greatly among healthy individuals, and there are presently no established normal values for the various minerals in hair. At this time, evaluation of nutritional status with regard to minerals by analysis of hair samples would seem to be of questionable value.

Clinical examination. The clinical examination is a useful tool in nutritional assessment. Many nutrient deficiencies may manifest themselves in oral lesions.²² Nizel¹³ believes that dentists should be able to recognize the clinical signs of nutritional problems, and should look for them routinely in examining patients. Sandstead et al.⁸³ have published a helpful guide to the diagnosis of nutritional disorders, which may be a valuable tool for the dentist.

Dietary evaluation. When using dietary intake data, the dentist should be aware of the strengths and weaknesses of food records, 24-hour recalls, food frequency questionnaires, and diet histories. It is necessary to keep in mind that dietary intake information may suffer from inaccuracy in recording or recalling foods consumed, and should not be taken as precise. Young et al.⁸⁴ found that the 24-hour recall did not accurately estimate nutrient intake when compared to the diet history or 7-day food record. For individuals, multiple 24-hour recalls averaged together may be more accurate than a single recall. The 7-day food record or diet history also

may give more precise information than a single recall. Hunt et al.⁸⁵ compared intake data obtained from a computerized food frequency questionnaire commonly used by dentists to data obtained from the average of five 24-hour recalls. The estimates of nutrients obtained from the two methods differed greatly with respect to all nutrients except carbohydrates, calories, protein and niacin. The 24-hour recalls gave a more accurate estimate of nutrient intake than did the other method. The accuracy of the computerized food frequency questionnaire is a limitation which should be kept in mind when the dentist is choosing a method for evaluation of dietary intake.

Tables which give nutrient composition of foods are useful in evaluating dietary intake data, but suffer from variation of nutrient content of a food from season to season, lack of data on some important trace minerals, and limited information on ethnic and convenience foods. In evaluating patients' dietary intake, the dentist must be able to apply the National Research Council's Recommended Dietary Allowances (NRC-RDA's) in an appropriate manner. The NRC-RDA's were designed for use in studying the nutrient intake of groups of people, and have limitations when evaluating the intakes of individuals.⁵⁴ The NRC-RDA's were established to make recommendations for intakes of nutrients that would cover the needs of most healthy persons in the U.S. It is important to remember that individual variation in nutrient need was considered in designing the NRC-RDA's, and that an intake of less than 100% for any given nutrient does not imply that a diet is deficient in that nutrient. The NRC-RDA's do not represent minimum daily requirements of individuals.⁵⁴

The assessment of nutritional status, when correctly used, can add a new dimension to preventive dental care. Education of dentists is

needed in order to insure appropriate usage of assessment techniques, tools, and findings.

Nutritional counselling has been effectively applied to the control of dental caries and to treatment of individuals with periodontal disease.^{13,18-20} Counselling also may be of benefit to patients with crowns, bridges and dentures. Counselling requires specialized training in the techniques of interviewing and one-to-one teaching. Odom et al.⁴⁶ stated that dentists and dental students should use the services of qualified dietitians and nutritionists in planning and conducting diet counselling. The team approach to nutritional counselling provides a more comprehensive plan of preventive dental care.

MATERIALS AND METHODS

Respondents

All students who were members of the 1st-year and 4th-year classes at the School of Dentistry at the University of Missouri at Kansas City (UMKC) during the Winter Semester of 1979 were asked to participate in this study. The 4th-year students were selected as the primary student population to be studied for two reasons. First, they had participated in 3 1/2 years of the program of study at the school, and had had the opportunity to apply their knowledge of nutrition to clinical dentistry for several years since taking a formal nutrition course during the first year. Second, these students would be graduating soon and would take to their practices the attitudes toward nutrition that they had developed while in school. The 1st-year students were selected as a comparison group. At the time of testing, they had just completed the formal nutrition course required of all 1st-year dental students at UMKC. In contrast

to the 4th-year students, they had not yet had experience in clinical dentistry.

The measuring instrument was administered to the 4th-year students during the first class period of "Community Dentistry Seminar," and to the 1st-year students during the final class period of "Nutrition." It was thought that collection of data in a class setting would yield a higher rate of return than a mail survey.

Development Of The Measuring Instrument

Approximately 75 true-false nutrition questions and 20 attitudinal statements concerning nutrition were developed. They were evaluated by 2 faculty members in the Department of Foods and Nutrition at KSU, and by 1 faculty member at the UMKC School of Dentistry. Items which were judged to be poorly-written or otherwise unacceptable were deleted or rewritten. An instrument was developed from the 50 best nutritional knowledge questions and the 15 best nutrition attitude statements. The instrument then was pretested on a group of graduate students and research assistants. The refined instrument was approved by the Committee on Research Involving Human Subjects at Kansas State University, and by the UMKC Health Science Human Experimentation Committee.

A letter of introduction, which gave a brief explanation of the research project, and an Informed Consent Form were attached to the measuring instrument (see Appendix). The instrument consisted of 3 sections: General Information about the student (age, sex, year in dental school, nutrition-related experiences, sources of nutrition information); a nutritional knowledge test; and a nutrition attitudes survey. A set of standardized instructions was developed to accompany the instrument, and was read to each group of students before they were allowed to begin

responding to the questionnaire. The questionnaires were collected immediately upon completion and were returned to the Department of Foods and Nutrition at Kansas State University for analysis.

For the nutritional knowledge test, subjects responded to 50 true-false questions, and indicated the degree of certainty they felt about their answers. This type of test has been used in other studies.^{1,3,86} The questions tested basic and applied knowledge of nutritional needs, nutrition in disease, nutrition in oral health and disease, diets, nutrients, foods, and nutritional assessment. For the nutrition attitudes survey, respondents indicated their strength of agreement with 15 attitudinal statements about nutrition, oral health, and patient care.

The Kuder-Richardson test⁸⁷ (KR-20) for internal consistency (reliability) was performed separately on the nutritional knowledge section and the nutrition attitudes section of the measuring instrument (Formula 5-10, Mehrens and Lehmann, pp. 99). Because of the manner in which the responses were scored (knowledge questions: correctness + degree of certainty; attitudes: strength of agreement range), coefficient alpha (α) was calculated. Coefficient α is a generalization of the KR-20 test when scoring of items is not dichotomous (right or wrong), but includes an additional dimension.

An α of 0.611 was obtained for the nutritional knowledge test, which indicated a somewhat low internal consistency (reliability). Mehrens and Lehmann⁸⁷ stated that a reliability of 0.65 is adequate to make decisions about groups of people, while 0.60 represents the lower limit of acceptability. Some factors which may have contributed to a low α on this test are homogeneity of the population tested, and limited variability of student scores on any particular question. A heterogeneous sample of

respondents tends to increase reliability. Furthermore, questions which give a wide range of scores, rather than nearly all students responding similarly, would tend to yield a higher α .

There was a great deal of variation from question to question in the percentage of students indicating complete uncertainty of the answer. One means of reducing this variation, and of improving the coefficient α for the KR-20 test would be to pretest the questionnaire on a random sample of the actual survey population, and compute the α for those subjects. Questions which were shown to be too easy or too difficult for a large number of students could then be rewritten or deleted.

An α of 0.753 was calculated for the nutrition attitudes portion of the questionnaire, which indicated good reliability. According to Mehrens and Lehmann⁸⁷ attitude scales are frequently less reliable than measures of cognitive knowledge. This was not true in our study. One reason for the good α level obtained might be the use of the Likert-type attitude scale (strongly agree - agree - uncertain - disagree - strongly disagree). This type of scale tends to yield a higher degree of reliability than other means of measuring attitudes, partly because it permits greater variance of subjects' responses.

Tabulation And Statistical Analysis Of Data

The Nutritional Knowledge Test responses were assigned a numerical value according to the correctness of the response and the degree of certainty, as follows:

<u>Subject Response</u>	<u>Degree of Certainty</u>	<u>Assigned Numerical Value</u>
Correct	5	+8
	4	+5
	3	+3
	2	+2
	1	+1
Incorrect	5	-8
	4	-5
	3	-3
	2	-2
	1	-1
Uncertain	---	0

A nutritional knowledge score for each individual was calculated by adding the point values for the 50 individual questions. Scores were analyzed by two-way analysis of variance by sex of subject and year in dental school.

The 15 Nutrition Attitudes responses were assigned a numerical value according to whether the response was favorable or unfavorable toward nutrition. A highly favorable attitude was assigned a value of +5; a moderately favorable attitude received a value of +2; a response of "no opinion" was scored 0; a moderately negative attitude was assigned a -2; and a highly unfavorable attitude toward nutrition was scored -5.

A nutrition attitudes score was obtained for each individual. As with the nutritional knowledge scores, two-way analysis of variance was performed in order to determine if there were differences between subjects attributable to sex or year in dental school.

A correlation coefficient was calculated between the nutritional knowledge score and the nutrition attitudes score.

RESULTS AND DISCUSSION

Respondents

Responses were obtained from 237 of the 316 1st and 4th-year dental students enrolled at UMKC. Because data was collected during regularly-scheduled classes, students who were absent from class on the day(s) of the data collection did not participate in the study. Of the 237 questionnaires returned, 7 were eliminated because of incomplete data or errors in responding to items. Two individuals handed in blank questionnaires. Usable data was obtained from 230 students (97 1st-year and 133 4th-year). Ten percent were female (1st-year, 10.3%; 4th-year, 9.8%). All of the subjects fell into the age range of 20 to 40 years of age; most were 20-29 years old.

Educational Background. Participants in the study were classified into 4 categories, according to their academic major prior to coming to dental school (Table 1). Approximately 68% had majored in the biological sciences (including biology, biochemistry, zoology, anatomy, physiology, agriculture, animal sciences, microbiology, botany, pharmacy, medical technology, dental hygiene, pre-dentistry, and health); 18% in the physical sciences (including chemistry, geology, physics, mathematics, engineering, and general science); 11% in the social sciences (including sociology, psychology, social work, public health, education, economics, management, and business); and only 3% in the humanities (including art, music, literature, speech and theater, philosophy, English, and foreign languages).

Subjects were also classified into 5 categories according to highest degree earned prior to coming to dental school (Table 2). Most (87.4%) had a Bachelor's degree but 6.1% had a higher degree, and 6.5% had no

Table 1. Distribution of respondents by academic major prior to dental school.

Academic major	% 1st-year	% 4th-year	% Total
Biological Sciences	72.4	64.8	68.2
Physical Sciences	17.3	18.8	18.0
Social Sciences	8.2	12.7	10.8
Humanities	2.1	3.7	3.0

prior degree. Students at UMKC Dental School are required to complete a specified number of semester credit hours before they may be admitted, but are not required to hold a bachelor's degree.

Table 2. Distribution of respondents by highest degree earned.

Highest degree earned	% 1st-year	% 4th-year	% Total
Bachelor's Degree	93.8	83.0	87.4
Master's Degree	3.2	6.6	5.2
Ph.D. Degree	0.0	1.5	0.9
Non-degree	3.2	8.9	6.5

Sources Of Nutrition Information. Subjects were asked to indicate classes which had served as their sources of nutrition knowledge. All dental students at UMKC are required to take a one-credit semester course in nutrition during the 1st-year. Less than 2% of the subjects had had any formal nutrition courses prior to coming to dental school. Other courses

from which students said they gained a knowledge of nutrition were bio-chemistry, biology, physiology, anatomy, human development, oral diagnosis, preventive dentistry, and periodontics. Most frequently named were bio-chemistry, biology, and physiology.

Students also were asked to indicate their sources of nutrition information other than classes. The textbook used in the nutrition course was often given as a source of information. Family members, newspapers, TV, dentists, friends, and the Journal of the American Dental Association were frequently named as sources of nutrition information. Nutritionists, health food stores, and meetings, workshops, and conferences were rarely listed.

Nutrition-Related Experiences. Respondents were asked to describe any practical experience they had had which related to nutrition. All 4th-year students had counselled one patient on nutrition as an assignment for part of their clinical dental experiences during the 3rd and 4th years of dental school. All the students had been required to keep a personal diet diary and analyze it for nutrient intake as an assignment for the nutrition course taken by 1st-year students. Other than these two assignments, nutrition-related experiences were rare. Only a few students reported using the techniques learned in these two assignments when working with patients in the dental clinic. Several students commented that they had never followed through on the techniques they had learned or that nutrition was never a topic of discussion when they were dealing with patients.

Scores For The Nutritional Knowledge Test

The possible maximum and minimum scores for the 50-question test were +400 to -400, based on correctness of response and degree of certainty.

Distribution of scores is shown in Table 3. Scores for each individual respondent are found in Appendix Table 18.

The highest nutritional knowledge score was +298 and the lowest score was +59. About 67% of the scores fell within the 101 to 200 range. There were approximately 22% above 200.

Table 3. Distribution of nutritional knowledge test scores.

Test score range	Respondents					
	1st-year		4th-year		Total	
	No.	%	No.	%	No.	%
251 - 298	6	6.2	0	0.0	6	2.6
201 - 250	26	26.8	19	14.3	45	19.5
151 - 200	39	40.2	49	36.8	88	38.3
101 - 150	21	21.6	44	33.1	65	28.3
59 - 100	5	5.2	21	15.8	26	11.3

The analysis of variance of nutritional knowledge scores (Table 4) indicated a highly significant difference between 1st-year and 4th-year students ($P < 0.0008$), with 1st-year students scoring higher than 4th-year students. Scores of males were not significantly different than scores of females. The mean scores for males, females, 1st-year, and 4th-year students are shown in Table 5.

The significantly lower nutritional knowledge scores made by 4th-year dental students may indicate that loss of information learned in their nutrition course had occurred in the three years that had elapsed since the course was taken. Apparently students need more practical application

Table 4. Analysis of variance for nutritional knowledge scores by sex and year in dental school.

Source of variation	DF	Mean squares
Year in dental school	1	24187.8**
Sex	1	450.2ns
Year/sex	1	975.4ns
Error	226	2112.5

**Indicates significance at the .01 level ns Indicates non-significance

Table 5. Mean nutritional knowledge scores.

Group	No. of subjects	Mean score
Males	207	163.0
Females	23	168.0
1st-year students	97	183.1
4th-year students	133	148.1
Total overall mean score	230	155.1

of the principles of nutrition, in order to reinforce learning and improve retention of nutrition information.

Correctness Of Response And Degree Of Certainty Percentages For Nutritional Knowledge Questions

The overall percentage of correct responses to nutritional knowledge questions was 68.6%. This was higher than the mean score (59%) on a

nutritional knowledge test made by dental students at the University of Kentucky.⁶ First-year students in the present study answered 71.6% of the questions correctly, while 4th-year students responded correctly about 66.6% of the time.

Percentages of group responses according to individual point values assigned (correctness of response and degree of certainty) were calculated (Table 6). The calculated percentages varied somewhat between the 1st-year and 4th-year students. The percentage of 1st-year students responding with a degree of certainty of +8 on the overall test was 4% higher than the percentage of 4th-year students indicating that degree of certainty. Thus, the 1st-year students were correct and sure of their answers more often than were 4th-year students. Fourth-year students received 2% more scores of -8 on the overall test than did 1st-year students. In general, neither group frequently indicated a low degree of certainty about their answers to questions; students either gave incorrect responses with moderate degrees of certainty, or indicated that they were completely unsure of their responses. Overall, 9.6% of 1st-year and 10.3% of 4th-year students were totally uncertain of their answers to questions. Conversely, 44.7% of 1st-year and 40.7% of 4th-year students were correct in their responses, with an extremely high degree of certainty.

Table 6. Overall percentage of group responses according to point values assigned.

Group	Correct Response					Incorrect Response					Uncertain 0
	+8	+5	+3	+2	+1	-8	-5	-3	-2	-1	
1st-year	44.7	13.4	9.6	2.2	1.6	7.9	4.5	4.9	0.9	0.7	9.6
4th-year	40.7	12.4	10.3	2.1	0.9	9.7	5.6	6.0	1.3	0.7	10.3

Discussion Of Individual Nutritional Knowledge Questions

RATES OF CORRECT RESPONSES TO INDIVIDUAL CATEGORIES
OF NUTRITIONAL KNOWLEDGE QUESTIONS

Category	Subject Matter Tested	% Correct Responses
Nutrition In Oral Health And Disease	Dental caries, periodontal disease, symptoms of vitamin deficiencies, tooth development, dentures, plaque formation, cariogenic factors	76.5
Foods	Sources of nutrients, food values, properties of foods, food fads	72.1
Nutrition In Disease States	Fever, infections, diabetes, hypoglycemia, anemia, osteoporosis, obesity, cardiovascular disorders, vitamin deficiencies	70.1
Nutrients	Toxicity of megadoses, calcium, phosphorus, fluoride, functions of nutrients, absorption and utilization of nutrients, interactions with medications	67.2
Nutrient Needs	Pregnancy, lactation, infancy, adolescence, old age, protein needs of athletes, effects of oral contraceptives	65.3
Diets	Vegetarianism, weight reduction, fad diets	60.8
Nutritional Assessment	Analysis of blood, urine and hair for evaluation of nutritional status, methods of dietary evaluation, NRC-RDA's	52.2

Nutrient Needs. Ninety-five percent of the subjects knew that lactation increases the requirements of a woman for calories, protein, calcium, vitamins and other minerals. Similarly, 89% were aware that the caloric

requirements of adolescent boys are greater than requirements for adult men. Three-fourths (75%) incorrectly believed that athletes need more protein in their diets than do sedentary individuals of similar height and weight. A majority of students in the study (85%) knew that vitamin and mineral supplements are not needed by most people in order to maintain good health. More than half (58%) of respondents were aware that oral contraceptives raise a woman's need for certain vitamins and minerals; however, 23% of subjects were completely uncertain about the answer to that question. Seventy-seven percent of participants in the study knew that iron is one nutrient that is likely to be inadequate in the diets of elderly persons. Less than one-fourth (23%) of the subjects knew that routine restriction of sodium is contraindicated in normal pregnancy, while 34% were completely unsure of the answer to that question. On the other hand, over four-fifths (84%) of the students realized that iron supplements are often required by pregnant women. More than half (55%) of the participants in this survey knew that breast milk alone does not provide adequate amounts of all the nutrients needed by infants for the first year of life.

Nutrition And Disease States. Nearly two-thirds of respondents (62%) knew that the presence of fever increases the body's needs for calories and other nutrients. Ninety percent of subjects realized that anemia may be caused by other factors than inadequate dietary intake of iron. About one-fourth (23%) of respondents held the mistaken notion that hypoglycemia is a major health problem among Americans, while an additional 16% were unsure of the real frequency and magnitude of the hypoglycemia problem. Nearly three-fourths (72%) of the dental students questioned were aware that persons whose lifelong calcium intakes are low are at greater risk

of developing osteoporosis than persons consuming higher levels of calcium. Almost all (97%) of the respondents knew that a low-cholesterol, low-sodium diet is frequently used in the treatment of cardiovascular diseases. Similarly, over 99% of subjects realized that obese persons may suffer from malnutrition. About 70% of the groups surveyed knew that megadoses of vitamin C will not prevent colds and infections or speed wound healing. Thirty-eight percent of subjects did not know that diminished taste and odor sensitivity are common manifestations of zinc deficiency. An additional 52% reported that they were completely unsure about the response to that question.

Nutrition In Oral Health And Disease. Overall, students scored high on knowledge of nutrition as it directly relates to dentistry. Slightly more than 90% of respondents correctly believed that poorly-fitting dentures may contribute to malnutrition. Only 12% of subjects failed to correctly recognize the classic oral signs of B-vitamin deficiencies. Surprisingly, however, 96% of the students were not aware that the oral manifestations of vitamin C deficiency (swollen, spongy gingival tissues that hemorrhage easily) do not occur in persons who have no teeth. Knowledge of such information is vital if a dentist is to be able to screen patients for vitamin deficiencies. Nearly all (96%) of respondents knew that milk should be included in the diets of humans, even after tooth eruption. A common myth is that milk consumption after infancy is unnecessary and possibly harmful to the teeth. Likewise, 93% were aware that putting a child to bed with a bottle of milk or fruit juice is a practice that encourages rampant decay of the maxillary incisors. Most (91%) of the students recognized the relationship between faulty maternal diet and abnormal tooth development in the offspring. Only one-third (32%) of the

respondents incorrectly believed that calcium would be withdrawn from the teeth to meet bodily needs if the diet was calcium-deficient. Over three-quarters of the group surveyed (77%) knew that a diet high in sucrose tends to increase the amount of dental plaque deposited on the teeth. In view of the emphasis placed by dentists on the relationship between sucrose consumption and plaque formation, the correct response rate on this question was surprisingly low. Some comments written in by students indicated that this question was somewhat ambiguously worded, which could account for the low rate of correct responses. Ninety-five percent of the dental students recognized the fact that frequency of carbohydrate consumption is just as important a contributory factor to caries development as is total carbohydrate consumption level.

Diets. In the category of diets, students at the UMKC School of Dentistry did not perform as well as they did in some of the other categories. This was also true with the dental students in the University of Kentucky study.⁶ Over one-half of subjects in the present study (57%) incorrectly believed that vegetarian diets are usually inadequate in protein. This finding was surprising, in view of the current popularity of vegetarianism. Forty percent of the respondents had the misconception that a low-carbohydrate, high-protein diet was ideal for weight reduction. Furthermore, while 62% of the students knew that one must burn 3500 more calories than one consumes in order to lose 1 pound of body fat, 25% were completely unsure about the answer to that question. Four-fifths of the respondents (82%) realized that bread and potatoes are not extremely calorie-dense foods and that they need not be eliminated from weight-reduction diets. About 69% rejected the common misconception that acidic foods, such as grapefruit, burn up body fat.

Nutrients. Eighty-six percent of the students surveyed were aware that large doses of vitamin A may cause toxic reactions in the body. Slightly less than two-fifths of the subjects knew that dietary phosphorus enhances the cariostatic properties of fluoride. Eighty-seven percent of the participants in the study realized that the calcium/phosphorus ratio of the diet is as important to good nutrition as the total dietary calcium intake. Only about 26% knew that heme iron from meat is better absorbed and better utilized than iron obtained from plant sources; an additional 25% indicated complete uncertainty in response to that question. Nearly everyone (98%) correctly answered the question that medications can interfere with the absorption and utilization of certain nutrients.

Foods. Only about one-half (47%) of the respondents knew that white bread is no more cariogenic than whole grain bread; 13% indicated that they had no idea about the relative cariogenicity of these two products. About 85% of the students questioned knew that honey elevates the blood glucose level to a similar extent as sucrose, and is therefore contraindicated for diabetics. Furthermore, 84% also were aware that honey is fermented by the oral microflora to organic acids, and contributes to dental caries, just as sugar does. Eighty-nine percent rejected the notion that organically-grown produce is more nutritious than fruits and vegetables grown with chemical fertilizers. Sixty-two percent of the participants in the study mistakenly believed that raw fruits and vegetables are the most abundant source of fiber in the diet. Eighty-two percent knew that skim milk contained the same amounts of protein and minerals as whole milk. About 40% of the students falsely identified peanut butter and chocolate as foods high in cholesterol. Nearly all (95%) of the subjects knew that carbonated beverages, which are rapidly cleared from the mouth after

ingestion, are not as cariogenic as are retentive foods, such as caramel candies. Similarly, 93% were aware of the fact that excessive intake of citrus fruits and juices, which are high in citric acid and other acids, may erode the tooth enamel.

Nutritional Assessment. Two-thirds (66%) of the respondents knew that measurement of urinary excretion levels of some nutrients or their metabolic products may give a more accurate picture of the status of those nutrients in the body than would be observed from analysis of a blood sample. Only about one-fourth (26%) of the dental students surveyed realized that the NRC-RDA's do not represent minimum daily requirements. Less than half (45%) of the subjects knew that hair analysis is not, at present, refined to the point of being a reliable means of assessing mineral status of humans; additionally, 28% more subjects indicated total uncertainty about the value of hair analysis in nutritional assessment. Lack of understanding of the information which can be gained from analysis of human hair may predispose dentists to inappropriate use of the technique in assessment of their patients' nutritional status. About 56% of the subjects knew that analysis of a blood sample cannot determine the status of certain vitamins and minerals in the body. Homeostatic control of some serum nutrient levels makes blood analysis of little value in assessing the body's reserves. Only 9% of the students surveyed incorrectly believed that a 24-hour recall gives a reliable estimate of a person's overall dietary intake, however, an additional 23% were completely unsure of the reliability of this method of dietary analysis. This finding indicates that dental students may need further training in methods of evaluating dietary intake if they are to be able to choose an accurate and appropriate means of obtaining information about the nutrient intakes of their

patients. If dentists are to function effectively as monitors of the nutritional status of patients, perhaps they need additional training in the appropriate assessment techniques to be used, in order to increase their knowledge of this topic.

Scores For The Nutrition Attitudes Survey

The possible maximum and minimum scores on the nutrition attitudes survey were +75 to -75, based on strength of agreement or disagreement with attitudinal statements favorable toward nutrition. Distribution of scores is shown in Table 7. Scores for each individual respondent are found in Appendix Table 18.

The highest nutrition attitudes score was 65, and the lowest was -35. Approximately 72% of the scores fell between 30 and 60. There were approximately 3.5% of the scores above 60, and 0.8% below 1.

Table 7. Distribution of nutrition attitudes scores.

Attitude score range	Respondents					
	1st-year		4th-year		Total	
	No.	%	No.	%	No.	%
60 to 65	5	5.2	3	2.3	8	3.5
45 to 59	30	30.9	47	35.3	77	33.5
30 to 44	39	40.2	50	37.5	89	38.7
15 to 29	21	21.6	23	17.3	44	19.2
0 to 14	2	2.1	8	6.0	10	4.3
-35 to -1	0	0.0	2	1.6	2	0.8

Two-way analysis of variance showed no significant differences in total nutrition attitudes scores between 1st and 4th-year students, or between males and females (Table 8). The mean scores for males, females, 1st-year and 4th-year students are shown in Table 9.

Table 8. Analysis of variance for nutrition attitudes scores by sex and year in dental school.

Source of variation	DF	Mean squares
Year in dental school	1	344.1ns
Sex	1	345.2ns
Year/sex	1	136.6ns
Error	226	201.5

ns Indicates non-significance

Table 9. Mean nutrition attitudes scores.

Group	No. of Subjects	Mean score
Males	207	38.8
Females	23	42.3
1st-year students	97	40.3
4th-year students	133	38.1
Total overall mean score	230	39.1

Discussion Of Individual Attitudes

Nutrition Attitudinal Statements

1. Nutrition is an essential part of total health care.
2. Dentists are a vital part of the health care team.
3. Good nutrition is important to dental health.
4. Nutrition should be emphasized in a dentist's educational preparation.
5. Dentists should be familiar with the physical symptoms of malnutrition and should look for them in their patients.
6. Poor oral health can adversely affect the general health of the entire body.
7. It is a responsibility of the dentist to disseminate nutrition and dietary information to his/her patients.
8. Dentists should know the principles of optimum nutrition and how to apply them.
9. Dentists should recommend or prescribe nutritional supplements for their patients.
10. The advice of a registered dietitian or nutritionist can be very helpful to a dentist in planning nutrition education for his/her patients.
11. A dentist should refer any patient who exhibits physical symptoms of malnutrition to a physician.
12. A thorough dietary history and food recall or record should be obtained from every patient as a part of the plan of preventive dental care.
13. A list of foods to avoid is adequate dietary instruction for my patients.
14. Proper nutrition is as important as proper oral hygiene in the prevention of oral disease.
15. In assessing the nutritional status of a person, one must consider his dietary habits, socioeconomic situation, blood nutrient levels, medications taken, general health, age, sex, and outward appearance.

Agreement with all of the statements except numbers 9 and 13 indicated a positive attitude toward nutrition. Overall there tended to be a high degree of agreement with most of the nutrition attitudes as they were stated (see Nutrition Attitudes Survey--Appendix). Two attitudinal statements, numbers 12 and 13, tended to show considerable disagreement. On 3 others, numbers 7, 9, and 11, students' opinions were less clearcut; a wider range of responses was obtained for these statements.

Approximately 85% of the 1st-year and 80% of the 4th-year students strongly agreed that nutrition is essential to total health care. Similarly, dentists were seen as a vital part of the health care team by almost all in both groups. Nearly all (98%) the students surveyed strongly agreed or agreed that good nutrition played an important role in dental health.

When asked if nutrition should be emphasized in a dentist's educational program, more 4th-year students strongly agreed, while more 1st-year students agreed but did not express strong agreement. There were a few undecided responses.

Almost identical numbers of each class of students strongly agreed (54%) and agreed (42%) that dentists should know how to diagnose nutritional deficiencies, and should routinely be on the lookout for them when examining patients. Likewise, both 1st and 4th-year students responded similarly, agreeing that poor oral health can lead to health problems in the rest of the body.

When asked whether they believed that a dentist had the responsibility to disseminate nutritional information to his patients, there was a considerable range of responses. Twice as many 4th-year (33.3%) as 1st-year (16.3%) students strongly agreed. Almost two-thirds of the 1st-year class

agreed, but did not feel strongly, while only two-fifths of the 4th-year class gave that response. Approximately 16% of each class was undecided on that issue, and 7-8% disagreed that dentists should become involved in nutrition education. About nine-tenths of both student groups strongly agreed or agreed that dentists should know how to apply the principles of good nutrition to daily practice.

When asked whether dentists should prescribe nutritional supplements for patients, opinions were widely divergent. Slightly over one-tenth of both groups strongly agreed. About twice as many 1st-year students (47%) as 4th-year students (26%) agreed, but not strongly. Almost one-fourth of the 1st-year respondents and about 40% of the 4th-year group were undecided. About 20% of both classes believed that a dentist should not prescribe supplements. Clearly, the controversy that exists in the field of dentistry with regard to nutritional supplementation is evident among the student population surveyed.

Most of the 2 groups of students (about 90%) agreed that qualified nutritionists and dietitians are valuable resources to be consulted concerning nutrition education of dental patients. There were some students who were undecided as to the role of these professionals.

There was some difference of opinion as to whether a dentist should refer patients suspected of being malnourished to a physician. Nearly half felt strongly that such patients should be referred, with more 1st-year than 4th-year students giving that opinion. More 4th than 1st-year students agreed, but not strongly. About 9-13% were undecided, and 5-9% stated that they disagreed.

Concerning nutritional care of dental patients, approximately 45% of the 1st-year and 70% of the 4th-year students disagreed or strongly

disagreed that dietary intake information should be obtained from every patient, as part of the plan of preventive dental care; one-fourth of the 1st-year and 15% of the 4th-year students were undecided. About 25% of the 1st-year respondents and 13% of the 4th-year respondents agreed or strongly agreed. The distribution of opinions on the topic of dietary instruction for dental patients was similar to that on dietary intake information; a majority of students felt that a list of foods to avoid was inadequate dietary instruction.

The diversity of opinions was broad when students were asked if nutrition was as important as oral hygiene in prevention of oral diseases. About 70% of the 1st-year and 50% of the 4th-year students agreed or strongly agreed. A few were undecided. Approximately one-fourth of each class disagreed, and some felt strongly about their disagreement. These responses were unexpected because of the strong emphasis in the dental literature on oral hygiene as the main preventive measure for oral diseases.

Nearly all of the students in both groups agreed or strongly agreed with the idea that one must consider a variety of factors in addition to diet (such as economic, cultural, biochemical and physical conditions) when assessing a patient's nutritional status. However there were a few who were undecided about this matter.

Correlation Of Nutritional Knowledge Test Score With Nutrition Attitudes Score

A correlation coefficient was computed relating nutritional knowledge test score to nutrition attitudes score. No significant relationship was found between the two variables ($r = -.086$).

General Discussion And Recommendations

Dentists are respected members of the health-care field, and because of this position, are consulted by patients about a variety of health-related topics. One of these is nutrition. Patients tend to regard the word of health professionals as absolute truth. This places a heavy responsibility on professionals, including dentists, to possess and disseminate accurate nutritional information. It is therefore important that students of dentistry gain a thorough knowledge of nutrition and its application in clinical dentistry.

The findings of this study indicated that 1st-year dental students were more knowledgeable about nutrition when tested immediately after taking their only formal nutrition course than were 4th-year students tested three years after they took the course. Over that time period, the application of nutritional knowledge to clinical dental experience apparently had been insufficient to reinforce learning. However, 4th-year students were, nevertheless, highly certain of the correctness of their responses to the test, even when those responses were wrong. This indicates that this group of students has misconceptions about nutrition of which they are unaware. Such misconceptions could conceivably render students vulnerable to the influence of charismatic proponents of ideas about nutrition which are unsubstantiated by scientific evidence.

Reinforcement of nutrition teaching is needed to improve retention of information by students and to aid in combatting misconceptions. Integration of nutritional principles into other courses in the dental curriculum would be one means of accomplishing this goal. Furthermore, students should be encouraged to apply nutritional principles to their clinical experiences during the 3rd and 4th years of the dental program. Some

unsolicited comments written on the questionnaires indicated that, at present, students apparently regard nutrition as an isolated subject and see little relationship of it with other areas of dentistry.

Because patients tend to place trust in the professional opinions and recommendations of dentists, nutritional misconceptions held by the dentist may be easily passed on. Dentists, and other health professionals, must not perpetuate nutrition misinformation, but instead should help to correct false beliefs held by the public. A sound understanding of the science and practice of nutrition is vital if the dentist is to function effectively in this role.

SUMMARY

The nutritional knowledge and attitudes of 230 dental students at the University of Missouri at Kansas City were studied. The questionnaire consisted of a letter of introduction, a general information form about the student, a nutritional knowledge test, a nutrition attitudes survey, and an informed consent form. The maximum and minimum possible scores on the 50-question nutritional knowledge test were +400 to -400, based on correctness and degree of certainty of responses. The maximum and minimum scores possible on the 15-statement attitude survey were +75 to -75, based on strength of agreement with the statements. The higher the nutrition attitude score, the more positive the attitude toward nutrition. First-year (97) and 4th-year (133) dental students, and males (207) and females (23) in the two classes were studied.

Approximately 67% of the nutritional knowledge scores fell within the 101 to 200 range; there were 22% above 200 and none below one. First-year students scored significantly higher than 4th-year students ($P < 0.0008$).

There were no differences in scores of males and females. Degrees of certainty for responses to questions varied somewhat between the two classes, with 1st-year students being more often correct with a higher degree of certainty. Overall, scores for questions from the "nutrition and dental health" category were the highest and scores for questions from the "nutritional assessment" category were the lowest. Approximately 72% of the nutrition attitude scores fell between 30 and 60; there were 4% above 60 and 1% below one. There were no significant differences in attitude scores attributable to sex of the respondent or year in dental school. No significant relationship ($r = -.086$) was observed between scores of nutritional knowledge and nutrition attitudes.

ACKNOWLEDGMENTS

The author wishes to thank the many people whose assistance and support helped to make this dream of mine come true. To Dr. Beth Fryer, my Major Professor and friend, I want to express my very special appreciation. Her sensitivity and understanding helped me more than she will ever know. When I needed encouragement, she was there to give me a gentle push. When I needed freedom, she stood back and let me make my own mistakes. She generously gave up many hours of her personal time to help me win an impossible race against the calendar. For these things, I will never forget her.

My thanks are given to Dr. Kathleen Newell and Dr. Allene Vaden, the other members of my advisory committee, for their valuable advice. These two great ladies typify the level of professional excellence to which I aspire. It was my good fortune to be able to work with them.

I sincerely thank Dr. H.C. Fryer, Professor of Statistics, for the analysis of the data. His technical expertise was vital to the project, and his warmth and humor were especially appreciated in the tense last moments.

I am deeply indebted to Dr. Pat Randolph, Department of Biochemistry and Nutrition, UMKC School of Dentistry. Without her help and influence, there would have been no study, and without her energies, the execution of the study would have been infinitely more complicated.

Gratitude is expressed to Dr. Kendall Porter, Dr. Harvey Eplee, and Dr. George Young, faculty members of the UMKC School of Dentistry, for their cooperation in the data collection. I especially want to thank the 1st and 4th-year dental students of 1978-1979 for their participation in the study.

Ora Cowan, Edgar Chambers IV, Jeannie Ostasz, Eunice Bassler, Joyce Oldenburg, Lu Ann Soliah, Joe Mathews, Nila Hines, Eleanor Vilander and Dr. Robert Reeves all have a special place in my heart. They gave me encouragement, sympathy, prayers, advice, and friendship. At times, they were the only thing that kept me going.

I want to thank my mother for the gifts she gave me long ago: love, confidence in myself, and a deep respect for learning. She started me down the path that ultimately led me here to study at KSU.

One very special person, more than any other, has my heartfelt thanks: Roger, the man I married. He listened to me, he helped me, he encouraged me, but more than that, he believed in me. He gave me the freedom to pursue this dream of mine. Without his patient love and support, I could not have made it come true.

Above all, I praise and thank the Lord for the many blessings He has given. During all the trials and tribulations of the past 13 months, He was with me.

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APPENDIX

STANDARD INSTRUCTIONS FOR QUESTIONNAIRE

This questionnaire is designed to gather important data about dental students' knowledge of and attitudes toward nutrition. It consists of three parts.

1. General information about you and your background
2. A nutritional knowledge test
3. A nutrition attitudes survey

Take a few moments to read the letter of introduction and the consent form. When you have read both of these carefully, sign the consent form and date it. Detach the signed consent form from the rest of the questionnaire and hand it in.

Please turn to the page with the heading "GENERAL INFORMATION." The data on this page is vital to the study. Please be as complete as possible in your answers.

In the upper right corner, in the blanks provided, please fill in ONLY the last four digits of your social security number. Let me stress again that this is only for the purpose of keeping track of the questionnaires. Your name will not be associated with your answers in any public or private report of the results of this study.

Where appropriate, use an "X" or a check mark to indicate your responses. Do not circle the responses on this page.

In section E, please be specific and as complete as possible. Description of your past experiences relating to nutrition is very helpful in evaluating the questionnaire.

In section F, please be sure to specify by name exactly which popular magazines, organizations, journals and newspapers are sources of nutrition information for you. If you check the blank indicating "other health professionals," please specify the profession in which the person or persons are involved.

Now turn to the page with the heading "NUTRITIONAL KNOWLEDGE TEST." Read the directions silently to yourself while I read them aloud.

DIRECTIONS: Please answer all questions without the help of textbooks, references or other people.

Some statements concerning nutrition are given below. Please indicate whether you think a statement is true or false. Circle "T" for True and "F" for False. After you have reached this decision, indicate the degree of certainty you feel about your answer. Circle:

- 5 if you are very confident that you have decided correctly.
- 4 if you are almost certain that you have decided correctly.
- 3 if you are half certain that you have decided correctly.
- 2 if you are not very sure that you have decided correctly.
- 1 if you are not sure of your answer, but have a guess or hunch.

If you are completely unsure of the answer to the question, circle "U," but do not indicate a degree of certainty.

Please be sure to circle both a response and a degree of certainty for all other questions.

Do you have any questions about the procedure to be used? Read each question carefully. They are not designed to trick you, but only to assess your knowledge of nutrition. Don't feel that you must spend a great deal of time on each question, but don't rush. Please respond to every question. There are 50 questions in all.

Now turn to the page headed "NUTRITION ATTITUDES SURVEY." Read the directions silently to yourself while I read them aloud.

DIRECTIONS: The following statements reflect attitudes toward nutrition and various aspects of patient care. We are interested in your judgment of each statement in terms of how well it reflects your attitude. There are no right or wrong answers to these statements. Circle:

- SA if you strongly agree with the statement.
- A if you agree but do not feel strongly about the statement.
- U if you are undecided or neither agree nor disagree with the statement.
- D if you disagree but do not feel strongly about the statement.
- SD if you strongly disagree with the statement.

Do you have any questions about the procedure to be used? Please respond to every attitude. There are 15 in all.

There is no time limit for completion of this questionnaire. It will probably take you about 20 minutes to respond. Please hand the questionnaire in when you have finished.

Thank you very much for your cooperation. Your participation in this study is greatly appreciated.



KANSAS
STATE
UNIVERSITY

Department of Foods and Nutrition

Justin Hall
Manhattan, Kansas 66506
913-532-5508

January, 1979

Dear Student of Dentistry:

Nutrition is currently a topic of great interest to health professionals and the lay public alike. Because of this awakening of interest, a large volume of information and misinformation concerning the relationship of nutrition to health has proliferated. Separating fact from fallacy is not an easy task, and health professionals are often consulted by their patients for answers to nutrition-related questions. For this reason, it is essential that professionals who give advice which affect the nutritional health of individuals be knowledgeable in this area.

A survey of 1st- and 4th-year students of the School of Dentistry at the University of Missouri at Kansas City, is being conducted, in order to assess knowledge of and attitudes toward nutrition. We request that you participate in this study. Responding to the attached questionnaire will take approximately 20 minutes of your time.

Please return the forms when you have finished responding to the questions.

This study has been approved by the UMKC Health Science Human Experimentation Committee and by the Committee on Research Involving Human Subjects at Kansas State University.

We sincerely appreciate your help in gathering information about this important area of health care. Thank you for your cooperation.

Most Sincerely,

Carol L. Pietz

Carol L. Pietz, R.D.
Graduate Student, KSU

Beth Fryer

Beth Fryer, Ph.D.
Professor of Nutrition, KSU

Kendall Porter

C. Kendall Porter, D.D.S.
Professor of Dentistry, UMKC
Chairman, Health Science Human
Experimentation Committee

Project Title: Nutritional knowledge and attitudes of 1st- and 4th-year dental students at the University of Missouri at Kansas City.

Investigators: Carol Pietz, R.D., M.S. Candidate
Beth Fryer, Ph.D., Professor of Nutrition

INFORMED CONSENT

This survey is being conducted under the Guidelines for Research Involving Human Subjects established by Kansas State University and has been approved by the Health Science Human Experimentation Committee at the University of Missouri at Kansas City.

Your cooperation will help to provide vital information about an important aspect of health care, however your participation is voluntary. We hope you will answer all the questions, but, should you think that any question represents an unreasonable invasion of your privacy, you may omit that question. The person who is administering the questionnaire will answer any further questions that you may have about this survey.

For bookkeeping purposes you will be asked to write the last four digits of your social security number on the questionnaire. No other means of identification will be requested of you. Confidentiality thus is guaranteed.

I have read the above statements and the letter explaining the nature and purpose of the research. I fully understand the procedures to be used and hereby volunteer to complete the questionnaire.

(date) _____ (signed) _____

NOTE: Please detach the signed consent form from the questionnaire before returning it. Consent forms will be collected separately from the questionnaires.

GENERAL INFORMATION

AGE	SEX	LAST FOUR DIGITS OF YOUR SOCIAL SECURITY NUMBER
20-29	<u>FEMALE</u>	_____
30-39	<u>MALE</u>	_____
40-49		_____
50-59		_____
60 and over	<u>YEAR IN DENTAL SCHOOL</u>	_____
	1st	_____
	4th	_____

EDUCATIONAL BACKGROUND

A. DID YOU HOLD A DEGREE BEFORE COMING TO DENTAL SCHOOL? YES NO
 IF NO, NUMBER OF SEMESTER CREDITS TAKEN BEFORE COMING TO DENTAL SCHOOL _____
 IF NO, NUMBER OF SEMESTER CREDITS IN NUTRITION TAKEN BEFORE COMING TO DENTAL SCHOOL _____
 IF NO, WHAT WAS YOUR MAJOR ACADEMIC EMPHASIS PRIOR TO COMING TO DENTAL SCHOOL?

B. WERE YOU INVOLVED IN A SPECIFIC "PRE-DENTAL" PROGRAM PRIOR TO COMING TO DENTAL SCHOOL?
YES NO

C. DEGREES HELD	MAJOR	YEAR RECEIVED	NUMBER OF SEMESTER CREDITS IN NUTRITION
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

D. CHECK OR LIST ALL OTHER COURSES IN WHICH YOU HAVE GAINED A KNOWLEDGE OF NUTRITION.

BIOCHEMISTRY	_____	ORAL DIAGNOSIS	_____
BIOLOGY	_____	PREVENTIVE DENTISTRY	_____
PHYSIOLOGY	_____	PERIODONTICS	_____
ANATOMY	_____	OTHER	_____
HUMAN DEVELOPMENT	_____		_____

E. BRIEFLY DESCRIBE ANY PRACTICAL EXPERIENCE YOU HAVE HAD THAT INVOLVED NUTRITION OR NUTRITIONAL COUNSELLING. (For example, jobs you have held, or nutrition counselling experience in a class or clinic, etc.)

F. CHECK OR LIST MAJOR SOURCES OF NUTRITION INFORMATION FOR YOU, OTHER THAN CLASSES.

BOOKS	_____
FAMILY MEMBERS	_____
FRIENDS	_____
NUTRITIONISTS	_____
OTHER HEALTH PROFESSIONALS (specify)	_____
HEALTH FOOD STORES	_____
DENTISTS	_____
POPULAR MAGAZINES (specify)	_____
MEETINGS, WORKSHOPS, CONFERENCES	_____
ORGANIZATIONS (specify)	_____
SCIENTIFIC JOURNALS (specify)	_____
TV	_____
NEWSPAPERS (specify)	_____
OTHER	_____

NUTRITIONAL KNOWLEDGE TEST

DIRECTIONS: Please answer all questions without the help of textbooks, references, or other persons.

Some statements concerning nutrition are given below. Please indicate whether you think a statement is true or false. CIRCLE "T" for TRUE and "F" for FALSE.

After you have reached this decision, indicate the degree of certainty you feel about your answer. CIRCLE:

- 5 if you are very confident that you have decided correctly.
- 4 if you are almost certain you have decided correctly.
- 3 if you are half certain that you have decided correctly.
- 2 if you are not very sure that you have decided correctly.
- 1 if you are not sure of your answer but have a guess or hunch.

If you are completely unsure of the answer to the question, circle "U" but do not indicate a degree of certainty.

Please be sure to circle both a response and a degree of certainty for each question.

			True, False or Uncertain	Degree of Certainty
1. Large doses of vitamin A can be toxic to the body.	T	F	U	5 4 3 2 1
2. A nursing mother requires more calories, protein, calcium, vitamins and minerals than the average woman.	T	F	U	5 4 3 2 1
3. A urine specimen may give a more accurate picture of the status of some nutrients in the body than does a blood sample.	T	F	U	5 4 3 2 1
4. A vegetarian diet is usually inadequate in protein.	T	F	U	5 4 3 2 1
5. Fever increases the need for calories and other nutrients.	T	F	U	5 4 3 2 1
6. White bread is more cariogenic than whole wheat bread.	T	F	U	5 4 3 2 1
7. Dentures that fit poorly can lead to malnutrition.	T	F	U	5 4 3 2 1
8. The Recommended Dietary Allowances represent minimum daily requirements of various age and sex groups within the American population.	T	F	U	5 4 3 2 1
9. A 13-year-old boy requires more calories than his 40-year-old father.	T	F	U	5 4 3 2 1
10. Hair analysis is a reliable method of determining a person's nutritional status with regard to minerals.	T	F	U	5 4 3 2 1
11. A high protein, low carbohydrate diet is ideal for weight reduction.	T	F	U	5 4 3 2 1
12. A diabetic may use honey as a sweetener because it is a natural sweetener, and does not elevate the blood glucose as sugar does.	T	F	U	5 4 3 2 1
13. Organically grown fruits and vegetables are more nutritious than those grown with chemical fertilizers.	T	F	U	5 4 3 2 1
14. The oral manifestations of vitamin C deficiency do not occur in edentulous individuals.	T	F	U	5 4 3 2 1
15. The cariostatic action of fluorine is enhanced by the presence of phosphorus in the diet.	T	F	U	5 4 3 2 1
16. An athlete requires more protein than a sedentary person of similar height and weight.	T	F	U	5 4 3 2 1
17. Analysis of a blood sample can determine if a person is getting all the vitamins and minerals he needs from his diet, in order to maintain good health.	T	F	U	5 4 3 2 1
18. The best source of fiber is raw fruits and vegetables.	T	F	U	5 4 3 2 1
19. Anemia may occur in persons whose dietary intake of iron is adequate.	T	F	U	5 4 3 2 1

20. Skim milk contains the same amounts of protein and minerals as whole milk. T F U 5 4 3 2 1

21. Angular fissures at the corners of the mouth, painful ulcerations of the oral mucosa, a swollen and inflamed tongue, and atrophy of the lingual papillae are symptoms that may be suggestive of B⁻ vitamin deficiencies. T F U 5 4 3 2 1

22. Most people require vitamin and mineral supplements to maintain good health. T F U 5 4 3 2 1

23. The ratio of calcium to phosphorus obtained from the diet is as important to good nutrition as the absolute amount of calcium ingested. T F U 5 4 3 2 1

24. Use of oral contraceptives increases a woman's need for certain vitamins and minerals. T F U 5 4 3 2 1

25. The 24-hour recall is a reliable assessment of a person's dietary intake. T F U 5 4 3 2 1

26. Iron is a nutrient which is often inadequate in the diets of the elderly. T F U 5 4 3 2 1

27. To lose one pound of body fat, one must burn 3500 calories more than one takes in. T F U 5 4 3 2 1

28. Hypoglycemia is a major health problem among the American population. T F U 5 4 3 2 1

29. The iron in meat is better absorbed and better utilized than iron from plant sources. T F U 5 4 3 2 1

30. Once the permanent teeth have erupted, a person should avoid milk in the diet. T F U 5 4 3 2 1

31. Peanut butter and chocolate are foods high in cholesterol. T F U 5 4 3 2 1

32. Putting a young child, whose teeth have erupted, to bed with a bottle of fruit juice or milk may lead to decay of the maxillary incisors. T F U 5 4 3 2 1

33. Medications can interfere with the absorption and utilization of nutrients. T F U 5 4 3 2 1

34. Persons who habitually consume a diet low in calcium are much more likely to develop osteoporosis than persons whose intake of calcium over the lifetime is high. T F U 5 4 3 2 1

35. Sweetened carbonated beverages and chewy caramels are equally cariogenic. T F U 5 4 3 2 1

36. Bread and pastries are high in calories and should be eliminated from the diet if one is trying to lose weight. T F U 5 4 3 2 1

37. Poor maternal nutrition during pregnancy may result in faulty development of the teeth of the child. T F U 5 4 3 2 1

38. A low cholesterol, low sodium diet is frequently used in the treatment of heart disease. T F U 5 4 3 2 1

39. An obese person may be malnourished. T F U 5 4 3 2 1

40. Honey is a natural sweetener and is therefore not fermented by the oral microflora to produce acids which erode the tooth enamel. T F U 5 4 3 2 1

41. Most pregnant women should restrict their intake of sodium. T F U 5 4 3 2 1

42. A very high intake of citrus fruits and juices may cause erosion of the tooth enamel. T F U 5 4 3 2 1

43. Iron supplements are often required during pregnancy. T F U 5 4 3 2 1

44. When the diet is deficient in calcium, calcium is lost from the molar teeth. T F U 5 4 3 2 1

45. Mother's milk provides all the nutrients an infant needs for the first year of life. T F U 5 4 3 2 1

46. A diet high in sucrose increases the amount of plaque on the teeth. T F U 5 4 3 2 1

47. Large doses of vitamin C (1 gram or more per day) will prevent colds and infections and will speed wound healing. T F U 5 4 3 2 1

48. Acidic foods, such as grapefruit, can be helpful in weight reduction because they burn body fat. T F U 5 4 3 2 1

49. Zinc deficiency may result in decreased taste and odor sensitivity. T F U 5 4 3 2 1

50. In the development of dental caries, frequency of ingestion of carbohydrates is as important a factor as the total amount of carbohydrate ingested. T F U 5 4 3 2 1

NUTRITION ATTITUDES SURVEY

The following statements reflect attitudes toward nutrition and various aspects of patient care. We are interested in your judgement of each statement in terms of how well it reflects your attitude. There are no right or wrong answers to these statements.

CIRCLE:

SA if you strongly agree with the statement.
A if you agree but do not feel strongly about the statement.
U if you are undecided or neither agree nor disagree with the statement.
D if you disagree but do not feel strongly about the statement.
SD if you strongly disagree with the statement.

PLEASE RESPOND TO EVERY STATEMENT

	<u>Strength of Agreement</u>
1. Nutrition is an essential part of total health care.	SA A U D SD
2. Dentists are a vital part of the health care team.	SA A U D SD
3. Good nutrition is important to dental health.	SA A U D SD
4. Nutrition should be emphasized in a dentist's educational preparation.	SA A U D SD
5. Dentists should be familiar with the physical symptoms of malnutrition and should look for them in their patients.	SA A U D SD
6. Poor oral health can adversely affect the general health of the entire body.	SA A U D SD
7. It is a responsibility of the dentist to disseminate nutrition and dietary information to his/her patients.	SA A U D SD
8. Dentists should know the principles of optimum nutrition and how to apply them.	SA A U D SD
9. Dentists should recommend or prescribe nutritional supplements for their patients.	SA A U D SD
10. The advice of a registered dietitian or nutritionist can be very helpful to a dentist in planning nutrition education for his/her patients.	SA A U D SD
11. A dentist should refer any patient who exhibits physical symptoms of malnutrition to a physician.	SA A U D SD
12. A thorough dietary history and food recall or record should be obtained from every patient as a part of the plan of preventive dental care.	SA A U D SD
13. A list of foods to avoid is adequate dietary instruction for my patients.	SA A U D SD
14. Proper nutrition is as important as proper oral hygiene in the prevention of oral disease.	SA A U D SD
15. In assessing the nutritional status of a person, one must consider his dietary habits, socioeconomic situation, blood nutrient levels, medications taken, general health, age, sex, and outward appearance.	SA A U D SD

Table 10. Nutritional knowledge questions by number as they were categorized into subject area.

Nutrient needs	Nutrition & disease	Nutrition & dental health	Diets	Nutrients	Foods	Nutritional assessment
2	5	7	4	1	6	3
9	19	14	11	15	12	8
16	28	21	27	23	13	10
22	34	30	36	29	18	17
24	38	32	48	33	20	25
26	39	37			31	
41	47	44			35	
43	49	46			40	
45		50			42	

CORRECT RESPONSES TO NUTRITIONAL KNOWLEDGE TEST

1. True	26. True
2. True	27. True
3. True	28. False
4. False	29. True
5. True	30. False
6. False	31. False
7. True	32. True
8. False	33. True
9. True	34. True
10. False	35. False
11. False	36. False
12. False	37. True
13. False	38. True
14. True	39. True
15. True	40. False
16. False	41. False
17. False	42. True
18. False	43. True
19. True	44. False
20. True	45. False
21. True	46. True
22. False	47. False
23. True	48. False
24. True	49. True
25. False	50. True

Table 11A. Percentage of correct group responses to "nutrients" questions according to point values assigned.

Question no.	+8		+5		+3		+2		+1	
	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th
1	67.0	57.1	16.5	16.5	6.2	7.5	1.0	1.5	0.0	0.0
15	8.3	13.5	5.2	7.5	16.5	12.0	6.2	5.3	1.0	1.5
23	71.1	51.1	12.4	15.8	7.2	12.8	1.0	2.3	1.0	1.5
29	14.4	1.5	7.2	8.3	11.3	4.5	1.0	2.3	3.1	2.3
33	69.1	83.5	18.6	10.5	7.2	4.5	1.0	0.0	1.0	0.0

Table 12A. Percentage of correct group responses to "nutrient needs" questions according to point values assigned.

Question no.	+8		+5		+3		+2		+1	
	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th
2	91.8	54.9	5.2	21.8	2.1	14.3	1.0	0.8	0.0	0.0
9	76.3	50.4	13.4	19.6	5.2	11.3	0.0	2.3	0.0	0.0
16	7.2	7.5	3.1	9.0	1.0	9.8	2.1	2.3	0.0	0.0
22	49.5	58.7	18.5	11.3	13.4	13.5	1.0	3.0	1.0	0.0
24	59.8	15.8	10.3	11.3	8.3	11.3	2.1	0.8	0.0	2.3
26	34.0	42.1	16.5	23.3	10.3	14.3	3.1	3.8	2.1	0.8
41	9.3	3.0	8.3	3.8	7.2	6.8	5.2	0.8	3.1	1.5
43	75.3	54.9	7.2	18.5	6.2	7.5	0.0	0.8	0.0	0.0
45	20.6	19.6	19.6	13.5	11.3	17.3	3.1	1.5	3.1	0.8

Table 11B. Percentage of incorrect and uncertain group responses to "nutrients" questions according to point values assigned.

Question no.	-8		-5		-3		-2		-1		0	
	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th
1	2.1	6.0	3.1	1.5	1.0	6.0	0.0	0.0	1.0	1.5	2.1	1.5
15	3.1	17.3	4.1	6.8	9.3	9.0	5.2	2.3	2.1	2.3	39.2	22.6
23	2.1	2.3	2.1	1.5	1.0	1.5	0.0	1.5	0.0	0.0	2.1	9.8
29	14.4	15.0	11.3	9.8	11.3	18.0	4.1	6.0	3.1	2.3	18.6	30.8
33	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	1.5

Table 12B. Percentage of incorrect and uncertain group responses to "nutrient needs" questions according to point values assigned.

Question no.	-8		-5		-3		-2		-1		0	
	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th
2	0.0	1.5	0.0	3.0	0.0	3.8	0.0	0.0	0.0	0.0	0.0	0.0
9	1.0	3.8	1.0	3.8	2.1	1.5	0.0	0.8	1.0	6.0	0.0	0.0
16	50.5	35.3	18.6	15.8	13.4	12.8	0.0	3.1	3.1	0.8	1.0	3.8
22	5.2	6.0	2.1	1.5	3.1	3.0	1.0	0.8	2.1	0.0	3.1	2.3
24	2.1	9.8	1.0	3.8	3.1	8.3	3.9	4.5	0.0	0.0	10.3	31.6
26	4.1	3.0	2.0	0.8	8.3	5.3	0.0	0.0	0.0	0.0	19.6	6.8
41	20.6	27.1	3.1	9.8	7.2	10.5	1.0	1.5	1.0	0.8	34.0	34.6
43	1.0	0.8	1.0	3.8	3.1	4.5	0.0	0.0	0.0	0.0	6.2	9.8
45	11.3	15.0	10.3	9.0	4.1	6.8	3.1	2.3	1.0	0.0	12.4	14.3

Table 13A. Percentage of correct group responses to "nutrition & disease" questions according to point values assigned.

Question no.	+8		+5		+3		+2		+1	
	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th
5	28.9	19.6	17.5	16.5	17.5	18.8	3.1	3.0	1.0	0.0
19	56.6	67.7	24.8	13.5	7.2	8.3	2.1	2.3	1.0	0.0
28	21.7	27.0	15.5	11.3	19.6	12.8	6.2	5.3	3.1	1.5
34	59.8	20.3	18.6	12.0	8.3	18.1	5.2	2.3	3.1	3.0
38	74.2	77.4	15.4	12.0	7.2	6.8	0.0	1.5	0.0	0.0
39	84.5	92.5	9.3	6.0	5.2	0.8	0.0	0.0	0.0	0.0
47	37.1	42.9	14.4	14.3	10.3	9.0	6.2	1.5	4.1	0.8
49	13.5	10.5	10.3	5.3	10.3	12.8	0.0	3.8	6.2	3.0

Table 14A. Percentage of correct group responses to "nutrition & dental health" questions according to point values assigned.

Question no.	+8		+5		+3		+2		+1	
	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th
7	66.0	72.2	13.4	12.0	9.3	3.8	1.0	3.0	0.0	0.0
14	1.0	1.5	2.1	0.0	1.0	0.8	1.0	0.0	3.1	1.5
21	51.6	48.1	17.5	21.8	10.3	15.8	1.0	1.5	7.2	0.8
30	82.5	68.4	13.4	16.5	3.1	7.5	0.0	1.5	0.0	0.0
32	88.7	76.7	6.2	5.3	2.1	6.0	0.0	0.8	1.0	0.8
37	70.1	51.9	18.6	13.5	10.3	15.0	0.0	3.0	0.0	0.8
44	25.8	57.9	8.3	12.8	11.3	8.3	5.2	3.8	2.1	0.0
46	60.8	48.1	21.7	8.3	3.1	7.5	3.1	0.8	3.1	1.5
50	82.5	89.5	9.3	3.8	3.1	2.3	0.0	0.0	0.0	0.0

Table 13B. Percentages of incorrect and uncertain group responses to "nutrition & disease" questions according to point values assigned.

Question no.	-8		-5		-3		-2		-1		0	
	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th
5	3.1	6.0	3.1	6.8	6.2	11.3	0.0	1.5	3.1	0.8	16.5	15.8
19	4.1	3.0	2.1	1.5	3.1	3.0	0.0	0.0	0.0	0.0	2.1	0.8
28	9.3	10.5	5.2	6.0	3.1	7.5	1.0	2.3	0.0	0.0	15.5	15.8
34	0.0	6.0	0.0	5.3	1.0	11.3	0.0	3.0	0.0	0.8	4.1	18.1
38	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	3.1	1.5
39	1.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	3.1	6.0	3.1	6.0	5.2	3.0	3.1	2.3	1.0	2.3	12.4	12.0
49	2.1	7.5	0.0	0.8	1.0	3.0	0.0	0.8	4.1	1.5	52.6	51.1

Table 14B. Percentages of incorrect and uncertain group responses to "nutrition & dental health" questions according to point values assigned.

Question no.	-8		-5		-3		-2		-1		0	
	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th
7	3.1	4.5	2.1	0.8	2.1	1.5	0.0	0.0	0.0	0.0	3.1	2.3
14	56.7	69.9	17.5	16.5	14.4	8.3	2.1	1.5	1.0	0.0	3.1	1.5
21	1.0	3.8	1.0	3.0	2.1	3.0	1.0	0.0	0.0	0.0	7.2	2.3
30	0.0	0.8	0.0	0.0	0.0	2.3	1.0	0.8	0.0	0.0	0.0	2.3
32	0.0	3.0	1.0	2.3	1.0	2.3	0.0	0.0	0.0	0.0	0.0	3.0
37	0.0	3.8	0.0	2.3	1.0	3.0	0.0	0.8	0.0	0.0	0.0	6.0
44	11.3	3.0	5.2	2.3	12.4	2.3	1.0	0.8	2.1	0.8	15.5	8.3
46	5.2	12.0	1.0	6.8	0.0	10.5	0.0	0.8	0.0	0.0	2.1	3.8
50	4.1	1.5	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	1.0	2.3

Table 15A. Percentage of correct group responses to "nutritional assessment" questions according to point values assigned.

Question no.	+8		+5		+3		+2		+1	
	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th
3	28.9	21.8	14.4	24.8	18.6	16.5	3.1	2.3	1.0	0.0
8	19.6	9.0	7.2	5.3	6.2	3.8	0.0	1.5	0.0	0.0
10	8.3	10.5	15.5	8.3	20.6	16.5	3.1	3.8	3.1	2.3
17	15.5	10.5	12.4	21.8	16.5	15.8	8.3	3.8	5.2	2.3
25	32.0	36.1	14.4	14.3	15.5	9.0	4.1	5.3	2.1	3.8

Table 16A. Percentage of correct group responses to "foods" questions according to point values assigned.

Question no.	+8		+5		+3		+2		+1	
	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th
6	20.6	20.3	10.3	9.0	15.5	12.8	1.0	0.8	1.0	0.8
12	52.6	49.6	18.6	18.8	9.3	12.8	1.0	3.8	1.0	1.5
13	77.3	59.4	5.2	12.8	7.2	12.0	1.0	2.3	1.0	0.0
18	19.6	11.3	14.4	6.0	8.3	9.0	0.0	0.8	0.0	0.8
20	26.8	46.6	14.4	14.3	14.4	18.1	1.0	3.8	3.1	0.0
31	16.5	21.0	12.4	11.3	14.4	7.5	8.3	3.8	0.0	1.5
35	74.2	82.0	11.3	8.3	8.3	3.8	1.0	0.0	0.0	0.0
40	62.9	57.9	14.4	15.0	7.2	9.8	3.1	1.5	0.0	0.0
42	61.9	71.4	20.6	9.0	9.3	6.8	5.2	0.8	1.0	1.5

Table 15B. Percentage of incorrect and uncertain group responses to "nutritional assessment" questions according to point values assigned.

Question no.	-8		-5		-3		-2		-1		0	
	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th
3	3.1	9.8	8.3	8.3	11.3	9.0	2.1	0.8	0.0	0.0	9.3	6.8
8	40.2	43.6	18.6	21.8	8.3	9.8	0.0	1.5	0.0	0.0	0.0	3.8
10	7.2	6.0	4.1	5.3	10.3	12.8	0.0	5.3	1.0	0.8	26.8	28.6
17	6.2	6.0	7.2	8.3	8.3	9.0	2.1	3.0	2.1	0.8	16.5	18.8
25	3.1	3.8	3.1	0.8	2.1	3.8	0.0	0.8	0.0	0.0	23.7	22.6

Table 16B. Percentage of incorrect and uncertain group responses to "foods" questions according to point values assigned.

Question no.	-8		-5		-3		-2		-1		0	
	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th
6	8.3	17.3	9.3	15.8	12.4	12.0	2.1	1.5	1.0	0.8	18.6	9.0
12	3.1	1.5	0.0	1.5	4.1	2.3	1.0	0.0	0.0	0.8	9.3	6.8
13	1.0	1.5	0.0	3.0	3.1	3.8	1.0	0.0	0.0	0.0	3.1	5.3
18	23.7	36.8	19.6	18.8	10.3	10.5	0.0	2.3	0.0	0.0	4.1	3.8
20	13.4	3.0	8.3	6.0	8.3	1.5	1.0	0.0	0.0	0.0	9.3	6.8
31	10.3	13.5	12.4	9.8	10.3	14.3	2.1	1.5	2.1	2.3	11.3	13.5
35	4.1	3.0	0.0	1.5	0.0	0.8	0.0	0.0	0.0	0.0	1.0	0.8
40	3.1	2.3	3.1	1.5	3.1	3.0	0.0	0.0	0.0	0.0	3.1	9.0
42	1.0	2.3	0.0	1.5	0.0	3.0	0.0	0.8	0.0	0.0	1.0	3.0

Table 17A. Percentage of correct group responses to "diets" questions according to point values assigned.

Question no.	+8		+5		+3		+2		+1	
	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th
4	10.3	18.1	12.4	13.5	7.2	9.8	0.0	0.8	1.0	0.0
11	37.1	21.8	21.7	9.0	8.3	14.3	1.0	0.0	1.0	1.5
27	38.1	23.3	14.4	10.5	11.3	15.0	3.1	3.8	4.1	3.0
36	44.3	46.6	24.7	24.8	7.2	6.0	3.1	3.8	0.0	0.0
48	35.1	35.3	16.5	14.3	20.6	12.8	1.0	1.5	3.1	0.0

Table 17B. Percentage of incorrect and uncertain group responses to "diets" questions according to individual point values assigned.

Ques- tion no.	-8		-5		-3		-2		-1		0	
	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th
4	28.9	23.3	19.6	15.8	12.4	10.5	1.0	2.3	0.0	1.5	7.2	4.5
11	4.1	8.3	6.2	20.3	10.3	14.3	3.1	2.3	1.0	3.0	6.2	6.0
27	5.2	6.8	0.0	3.0	4.1	4.5	0.0	0.0	1.0	0.0	18.6	30.8
36	6.2	5.3	3.1	5.3	5.2	4.5	1.0	1.5	1.0	0.0	4.1	2.3
48	1.0	6.0	2.1	0.0	1.0	5.3	2.1	1.5	1.0	3.8	16.5	19.6

Table 18. Individual scores to nutritional knowledge test and nutrition attitudes survey.

Subject no.	Knowledge score	Attitude score	Subject no.	Knowledge score	Attitude score
1	144	42	47	171	52
2	152	52	48	140	31
3	171	53	49	210	25
4	110	57	50	170	31
5	182	35	51	119	38
6	104	45	52	136	43
7	155	42	53	220	28
8	168	28	54	153	34
9	144	0	55	105	9
10	81	45	56	169	33
11	215	26	57	165	47
12	200	38	58	181	37
13	186	46	59	92	59
14	221	15	60	245	21
15	222	52	61	130	34
16	159	37	62	91	37
17	155	33	63	72	53
18	254	21	64	219	49
19	111	55	65	122	53
20	161	29	66	199	54
21	94	60	67	206	50
22	138	19	68	145	36
23	170	35	69	161	55
24	120	28	70	239	7
25	80	30	71	148	45
26	151	37	72	111	34
27	192	12	73	94	42
28	156	41	74	235	36
29	171	49	75	154	38
30	168	50	76	112	32
31	92	31	77	79	40
32	184	22	78	105	54
33	133	14	79	203	0
34	192	36	80	189	40
35	111	35	81	227	29
36	171	23	82	137	45
37	112	-35	83	75	62
38	147	35	84	176	12
39	120	50	85	156	23
40	177	27	86	194	27
41	229	36	87	161	46
42	153	50	88	189	65
43	210	53	89	84	32
44	214	48	90	141	56
45	235	49	91	101	26
46	156	44	92	174	43

Table 18. (Continued).

Subject no.	Knowledge score	Attitude score	Subject no.	Knowledge score	Attitude score
93	77	21	139	252	57
94	179	46	140	178	53
95	144	65	141	197	28
96	103	60	142	151	53
97	172	52	143	216	51
98	164	56	144	180	55
99	137	47	145	213	44
100	123	17	146	115	38
101	159	65	147	124	42
102	149	55	148	90	47
103	216	44	149	151	42
104	141	-5	150	110	29
105	124	37	151	221	54
106	158	53	152	154	43
107	63	44	153	129	41
108	259	19	154	225	19
109	148	24	155	196	55
110	176	49	156	63	57
111	73	6	157	144	49
112	195	37	158	211	43
113	97	55	159	189	37
114	148	21	160	72	32
115	186	13	161	266	34
116	117	47	162	192	47
117	194	41	163	113	34
118	59	39	164	165	59
119	184	50	165	113	29
120	216	25	166	111	65
121	248	29	167	179	53
122	194	35	168	181	28
123	323	30	169	153	57
124	153	52	170	129	44
125	135	44	171	104	43
126	126	39	172	298	35
127	210	44	173	146	26
128	212	38	174	76	47
129	122	52	175	238	20
130	167	46	176	173	19
131	160	50	177	104	25
132	181	41	178	234	37
133	200	55	179	192	36
134	113	49	180	205	49
135	129	24	181	140	33
136	168	49	182	219	44
137	238	39	183	147	30
138	240	27	184	140	34

Table 18. (Continued).

Subject no.	Knowledge score	Attitude score	Subject no.	Knowledge score	Attitude score
185	65	40	208	88	49
186	232	37	209	165	28
187	236	51	210	201	26
188	93	23	211	226	29
189	155	28	212	139	57
190	113	38	213	160	36
191	96	36	214	118	51
192	221	57	215	218	42
193	224	39	216	174	43
194	235	20	217	149	18
195	232	25	218	182	48
196	256	41	219	220	42
197	161	48	220	194	55
198	152	20	221	134	51
199	215	59	222	155	38
200	196	42	223	125	37
201	185	42	224	122	34
202	150	53	225	159	49
203	154	44	226	96	50
204	144	47	227	182	22
205	161	42	228	209	56
206	87	63	229	160	38
207	151	31	230	160	55

Table 19. Class percentage responses to nutrition attitudes.

Response	Strongly agree		Agree		Undecided		Disagree		Strongly disagree		
	Class	1st	4th	1st	4th	1st	4th	1st	4th	1st	4th
Attitude no.											
1		84.7	80.3	14.3	18.9	1.0	0.0	0.0	0.0	0.0	0.8
2		87.8	88.6	11.2	11.4	1.0	0.0	0.0	0.0	0.0	0.0
3		82.7	81.4	17.3	17.0	0.0	0.0	0.0	0.8	0.0	0.8
4		40.8	57.6	52.1	34.8	6.1	5.3	1.0	0.8	0.0	1.5
5		54.2	54.5	42.7	41.7	3.1	2.2	0.0	0.8	0.0	0.8
6		80.6	79.2	19.4	19.2	0.0	0.8	0.0	0.8	0.0	0.0
7		16.3	33.3	58.2	41.7	16.3	16.7	8.2	6.8	1.0	1.5
8		33.7	40.9	59.2	46.2	7.1	9.1	0.0	3.0	0.0	0.8
9		11.2	12.9	46.9	25.8	24.5	40.1	15.3	14.4	2.1	6.8
10		37.8	40.5	53.1	45.8	7.1	10.8	1.0	1.5	1.0	1.5
11		48.4	41.4	28.3	44.3	13.2	9.0	9.1	4.5	1.0	0.8
12		7.1	7.6	18.4	6.6	25.5	15.0	33.7	45.0	15.3	25.8
13		2.0	4.5	10.2	10.6	23.6	27.5	48.9	45.9	15.3	11.5
14		30.2	22.0	40.6	31.0	7.0	12.0	18.2	28.4	4.0	6.6
15		58.2	48.8	41.8	43.4	0.0	6.2	0.0	0.8	0.0	0.8

NUTRITIONAL KNOWLEDGE AND ATTITUDES OF STUDENTS
AT THE UMKC SCHOOL OF DENTISTRY

by

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B.S., Colorado State University, 1975

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Foods and Nutrition

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1979

The nutritional knowledge and attitudes of 230 dental students at the University of Missouri at Kansas City were studied. The questionnaire consisted of a letter of introduction, a general information form about the student, a nutritional knowledge test, a nutrition attitudes survey, and an informed consent form. The maximum and minimum possible scores on the 50-question nutritional knowledge test were +400 to -400, based on correctness and degree of certainty of responses. The maximum and minimum scores possible on the 15-statement attitude survey were +75 to -75, based on strength of agreement with the statements. The higher the nutrition attitude score, the more positive the attitude toward nutrition. First-year (97) and 4th-year (133) dental students, and males (207) and females (23) in the two classes were studied.

Approximately 67% of the nutritional knowledge scores fell within the 101 to 200 range, there were 22% above 200 and none below one. First-year students scored significantly higher than 4th-year students ($P < 0.0008$). There were no differences in scores of males and females. Degrees of certainty for responses to questions varied somewhat between the two classes, with 1st-year students being more often correct with a higher degree of certainty. Overall, scores for questions from the "nutrition and dental health" category were the highest and scores for questions from the "nutritional assessment" category were the lowest. Approximately 72% of the nutrition attitude scores fell between 30 and 60; there were 4% above 60 and 1% below one. There were no significant differences in attitude scores attributable to sex of the respondent or year in dental school. No significant relationship ($r = -.086$) was observed between scores of nutritional knowledge and nutrition attitudes.